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MINNESOTA

Center for Transportation Studies

Presents . .

GIS AS A PAVEMENT & ASSET MANAGMENT TOOL

Thursday, February 11, 1999
Best Western Edgewater East, Duluth, MN

Tuesday, February 16, 1999
Holiday Inn, Burnsville, MN

Wednesday, March 3, 1999
Best Western Apache, Rochester, MN

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&

Instructors

Workshop Agenda & Instructors

WORKSHOP AGENDA

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8:45 - 9:15	Introduction to Asset Management Systems	Darwin Dahlgren
9:15 - 9:45	Introduction to Geographical Information Systems (GIS)	Mark Wald
9:45 - 10:00	Linking Pavement Management Data and GIS (conceptual)	Mark Wald
10:00 - 10:15	BREAK	
10:15 - 11:15	Data Collection Options	
	▸ Pavement/Asset Management Data: Pros and Cons	Darwin Dahlgren
	▸ Spatial Data: Pros and Cons	Mark Wald
11:15 - 11:30	Massaging GIS Data	Mark Wald
11:30 - 12:00	Morning Summary and Q & A	Darwin & Mark
12:00 - 12:45	LUNCH	
12:45 - 3:15	Case Study Applications	
	Washington County -- Pavement Management System & Analysis ▸ Case study featuring software demonstration	Darwin Dahlgren
	Linking Pavement Management Data and GIS (functional)	Darwin & Mark
	Manitowoc County -- Snow Plow Maintenance Facilities Planning	Mark Wald
	McLeod County -- Ditch Maintenance Record Keeping	Mark Wald
	McLeod County -- Emergency Dispatch and Rural Addressing	Mark Wald
	BREAK	
	Sign Management Case Study	Darwin Dahlgren
	MnDOT -- Hydraulic Infrastructure (manual only)	Mark Wald
3:00 - 3:30	Implementation Principles: How to Get Started	Darwin Dahlgren
3:30 - 3:45	Question and Answer	All

WORKSHOP INSTRUCTORS

Darwin Dahlgren is Director of Asset & Pavement Management Programs for Braun Intertec

Daniel Schmidt is GIS Manager with the Minneapolis-based firm of Braun Intertec

Mark Wald is a GIS Planner/Coordinator for OSM & Associates

GIS as a Asset Management Tool

Thursday February 11, 1999
8:30 a.m. to 4:30 p.m.
Best Western - Edgewater/East,
Duluth, MN
Co-sponsored by Technology Transfer Program, Center for Transportation Studies, University of Minnesota

GIS as a Asset Management Tool

- Introduction to Asset Management and GIS Systems
- Overview of Data Collection and Integration Process
- Asset Management Systems using the GIS tool
- Asset Management and GIS Implementation Principles
- Questions and Answers

GIS as a Asset Management Tool

- **8:30-8:45 Introductions of Instructors and Participants**
- **8:45-9:15 Intro to Asset Management Systems**
- **9:15-9:45 Intro to Geographic Information Systems**
- **9:45-10:00 Linking Pavement Management Data and GIS (Conceptual)**
- **10:00-10:15 BREAK**

GIS as a Asset Management Tool

- **10:15-11:15 Data Collection Options**
  - Pavement/Asset Management Data – Pros/Cons
  - Spatial Data – Pros/Cons
- **11:15-11:30 Massaging GIS Data**
- **11:30-11:45 Linking Pavement Management Data and GIS (Functional)**
- **11:45-12:45 LUNCH**

GIS as a Asset Management Tool

- **12:45-3:30 Application Examples**
  - Pavement Management
  - Snowplow Routing
  - Ditch Mapping
  - Rural Addressing
  - Sign Management

GIS as a Asset Management Tool

- **3:30-4:00 Implementation Principles**
- ***Who, What, How***
- **4:00-4:30 Question and Answer**

Introduction to
Asset Management Systems

Introduction to Asset Management Systems

- What is an Asset Management System?

Introduction to Asset Management Systems

- Definition of - Is
  - Depends on how you use the word

    (President Clinton)
- Definition of - Asset
  - 1.) An item of property
  - 2.) A useful or valuable thing or quality

    (Funk & Wagnalls)

Introduction to Asset Management Systems

- Definition of Management
  - 1.) The act, art, practice of managing
  - 2.) The person or persons who manage a business, etc..

    (Funk & Wagnalls)

Introduction to Asset Management Systems

- Definition of System
  - 1.) Orderly combination or arrangement of parts, elements, etc., into a whole; especially such combinations according to some rational principle
  - 2.) Any group of facts, concepts, and phenomena regarded as constituting a natural whole for purposes of philosophic or scientific investigation and construction

(Funk & Wagnalls)

Introduction to Asset Management Systems

- Is this property useful or valuable?
  - Pavements
  - Pavement markings
  - Sewers
  - Signs
  - Bridges
  - Culverts
  - Utilities (unless the agency does not own them)

Introduction to Asset Management Systems

- Why Implement a Asset Management System?
- To be more proactive than reactive
  - Build upon the Agency's collective management knowledge
  - Ask orderly combinations of "what if" questions
  - Need a rational principle for long range data analysis

Introduction to Asset Management Systems

- Information for the entire organization
  - Design - What's working?
  - Maintenance and Rehabilitation -
    - Where should we be working?
    - When should we be there?
    - What should we be doing?
  - Administration - How much should we be spending?
  - Elected officials - What is the benefit of funding?
  - Other Departments - How to better coordinate work?

Introduction to Asset Management Systems

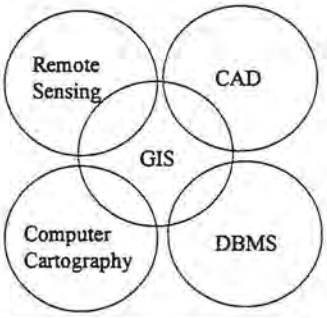
- Why not to implement a Asset Management System
  - To replace judgment (just enhance it with latest technology)

Introduction to GIS

Introduction to GIS

- A computer system that stores and analyzes data describing places on the earth's surface
- An organized collection of computer *hardware*, *software*, geographic *data*, and *personnel* designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information (ESRI)

Introduction to GIS



Introduction to GIS

Components of GIS

People

- Are the most valuable resource

Components of GIS

Hardware

- PC or UNIX workstation
- Plotters and printers
- Backup and data exchange

Components of GIS

Software

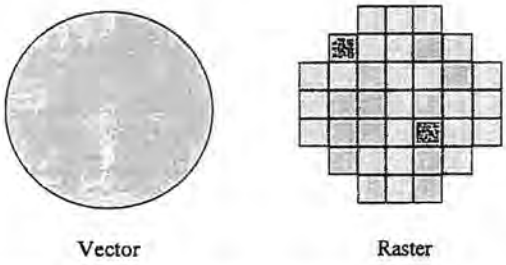
- Software ranges in the degree of robustness
  - Simple display of data and querying abilities
  - Desktop GIS - limited data creation and analysis
  - Full GIS - complete GIS processing functionality
- Software and market niches
  - scientific/research
  - traditional uses (mapping, environmental, planning)
  - enterprise applications (utilities, telecommunications, government, transportation)

Components of GIS

Data

- Spatial Data
  - The "graphics" storing the position of the geographic feature
  - Vector, Raster, TIN (Triangular Irregular Network)
  - Vector data types: spaghetti, arc-node topology
- Attribute Data
  - Information describing a geographic feature
  - Is "linked" to the geographic feature

Spatial Data Types



Vector Raster

Components of GIS

Methods

- How we interact with the software and data to get results
- A typical lifecycle of a GIS project:
  - Data Input
  - Refining the data (pre-processing)
  - Database management
  - Analysis
  - Output

Data Input

- End goals define data needed and collection method
- Data is organized in "layers" (roads, parcels, signs)
- Do-It-Yourself
  - Digitizing - COGO - CAD
  - Scanning - GPS - Data Entry
- Existing Data Sources
  - Government Agencies
  - Vendors
- Most time consuming and expensive step

Data Pre-Processing

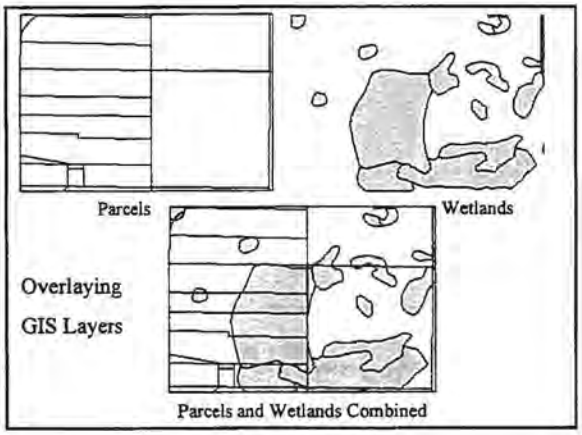
- Making existing data usable for analysis
- Sometimes referred to as "scrubbing" the data
- Examples:
  - correcting attribute codes
  - changing the map projection of the spatial data
  - making sure that lines connect to each other

Database Management

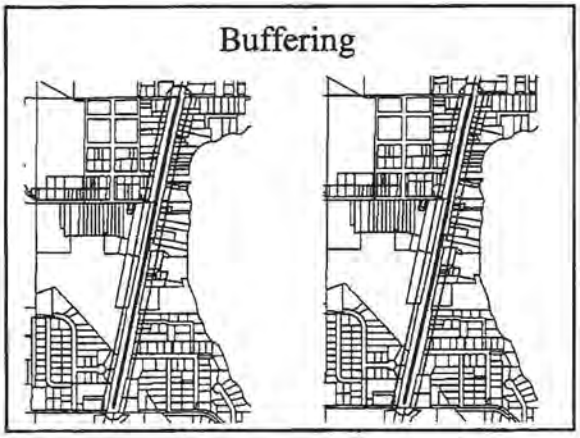
- GIS uses a relational database model (RDMS)
- Adding information by joining or linking two or more databases

Analysis

- Query & Retrieval - Inventory of Assets
  - "What is at ?" and "Where is?"
- Determining spatial patterns and trends
- Overlay of GIS layers
- Buffering
- Calculation of area and distance
- Modeling "what if" scenarios
  - road network modeling - delineation of drainage basins
  - 3D visualization - viewing data tables with maps



Buffering



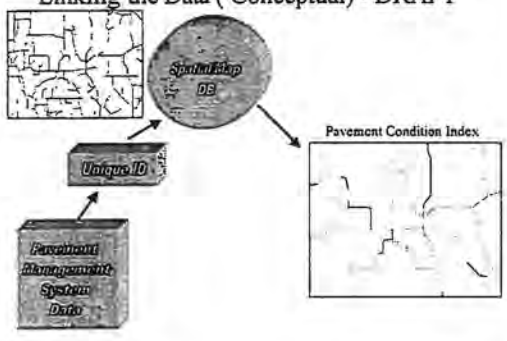
Output

- Communicating the results of analysis
- Maps
  - hard copy on paper
  - soft copy on computer screen
  - dynamic maps which change as databases are updated
- Reports
- End user-applications
  - mapping tax parcels
  - mapping vehicle crash sites

Linking Pavement Mangement and GIS Data

- Allows you to view the results of your pavement management system by looking at a map
- Attribute data is stored in the pavement management database
- Spatial data is stored in the GIS database
  - could be a GIS layer of roads, signs, ...
- The key is that each road segment has a unique identification number
- ID numbers in the pavement management and GIS database correspond to each other

Linking the Data (Conceptual) - DRAFT



Linking the Data

ID	Name	PCI
108	Nature Ave	85
109	220th St	85
110	225th St	90

ID	Length
108	2593.771
109	5242.192
110	2678.281

Data Collection:

The What & How

Data Collection - The What & The How

Pavement/Asset Management Data

Data Collection Options

- What data do we need to collect to answer the what if questions?
  - Lets look at the pavement asset

Pavement Data

- Complete inventory
  - Location
  - Dimensions
  - Material
- Historical information
  - Design
  - Date constructed
  - Maintenance type and dates
  - Traffic (projection)

Pavement Data

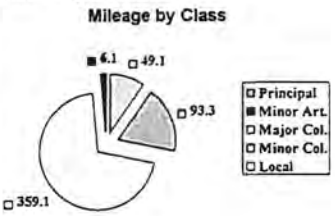
- Condition Data
  - Distresses
  - Quantities
  - Profile
  - Environmental

Data Collection Methods

- Collection methods - manual, semi-, fully-automated

Inventory and Condition Data

- Video produced by the LRRB



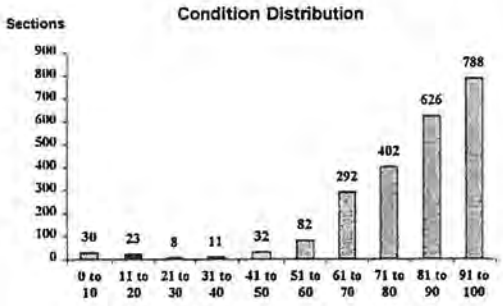
Inventory Data

- Mileage by Functional Class

Condition Data

- Typical Pavement Condition Index Information

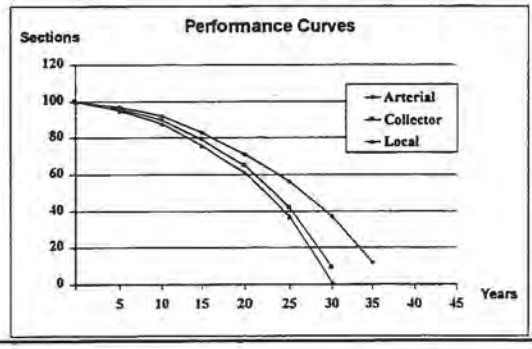
Current Condition Analysis



Pavement Data

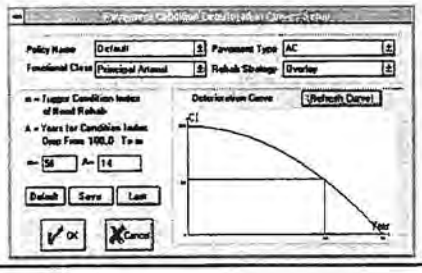
- Performance Data
  - Soils
  - Material
  - Construction
  - Condition Index
- Relevant Maintenance and Rehabilitation Strategies
  - Levels of maintenance work (not lumped together)
    - Localized distress repair i.e.., full-depth patch for a pothole
    - Overall pavement surface repair strategies i.e.., overlay

Use Modeling

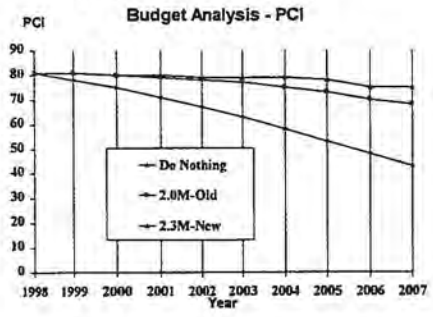


Use and Material Modeling

- Individual performance curves



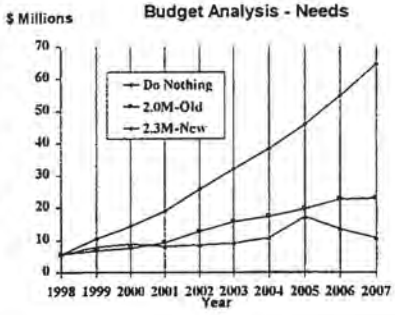
System Wide Modeling (Condition Analysis)



Pavement Data

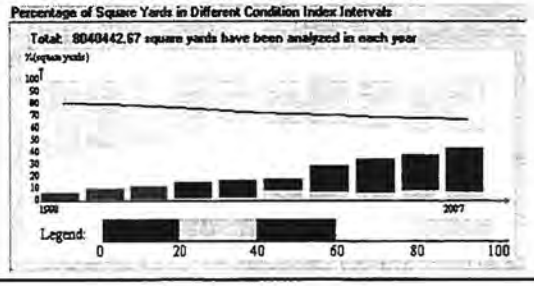
- Cost data
  - Material
  - Personnel
  - Design
- Spatial attributes
  - Political area
  - Work area
  - Construction area

System Wide Modeling (Needs Analysis)



System Wide Modeling (Budget based condition distribution)

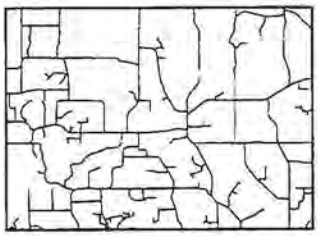
- Condition Distribution for 2.0M Budget and Current Policy



Spatial Data Sources

Spatial Data Sources

Vector Data Sources



MnDOT Base Map '99

- Road files in GIS format
- Up-to-date highways, CSAH and county roads as of Jan. 1, 1999
- Township & city roads current as of Jan. 1, 1994
- Accuracy: +/- 40 Feet
- Other data: civil divisions, hydrography, PLS....
- Cost: public - FREE private - $20
- Bob Wolbeck; Mn/Dot; MS 642; 395 John Ireland Blvd.; St.Paul, MN 55155 651-215-1973

MnDOT Base Map '98

PROS

- Data is ready to use
- Data covers the entire state
- Data is inexpensive

CONS

- Not high accuracy
- Some data processing required for developing custom data sets
- Township and city streets are not updated

Met Council - TLG Geographic Base File

- In GIS format
- Range includes 7 county metro area as well as Chisago, Isanti, Wright, Sherburne and St. Louis counties
- Data currency varies. Updates are done annually at a minimum
- Differing degrees of horizontal positional accuracy. Based largely on ROW data or pavement centerlines provided by the counties
- Ready for geocoding and networking applications
- Rick Gelbmann (Met Council) 651-602-1371 or Jim Maxwell (TLG) 612-341-9274

Met Council - Geographic Base File

PROS

- Ready to use, up-to-date, accurate data set
- Free for government agencies

CONS

- Limited coverage
- Accuracy varies

TIGER/Census Files

- Geographic base file including streets
- Developed from 1:24,000 & 1:100,000DLG files
- Cost: $250/CD (several states per CD)
  $1,500 Entire Country
- Contact:
  - Phone: 301 457-4100
  - Web: www.census.gov/geo/www/tiger/index.html

TIGER/Census Files

PRO

- Low Cost
- Covers entire country
- Good clean source for base data

CON

- Quality is suspect because of sources
- Rural areas have less precise coverage

Enhanced TIGER Files

- Vendor enhanced TIGER Files
- Straighten lines, add road names, add features
- Vendors:
  - ETAK - 800 765-0555 www.etak.com
  - ADC - 800 236-7973 www.adci.com
  - GDT - 800 331-7881 www.geographic.com
  - WESSEX - 800 892-6906 www.wessex.com
  - ESRI StreetMap - 800 447-9778 www.esri.com

Enhanced TIGER Files

PRO

- Quality is better than Base TIGER
- Updated more frequently

CON

- More expensive $500 - $10,000
- Updated coverage is limited to specific areas

CAD Drawings

- Incorporating existing CAD drawings into a GIS and maintaining inventory in GIS environment
- Maintaining database in road inventory in CAD and converting to GIS periodically.

CAD Drawings

PROS

- Using CAD and GIS for their strengths
- Data development done in-house

CONS

- Conversion from CAD to GIS may not be simple
- CAD road name annotation does not translate into a GIS as nicely

Global Positioning System

- Uses satellites to determine vertical and horizontal position
- 24 satellites orbit the earth
- Need to 4 satellites to get accurate readings
- The coordinates of a position are collected at a defined time interval
- Points, lines and polygons can be collected
- Attribute data can be collected in the field

GPS

- Output to many GIS and mapping formats
- Output to many coordinate systems and datums
- Integration with external sensors
  - laser rangefinder, barcode wands, digital cameras
- Base GPS: 100 m accuracy
- Many sources of error

GPS: Differential GPS

- Differential GPS - Corrects the most of the error
- Uses info from known location to correct errors
- Real-time or post-processing
- USCG beacon or satellite correction
- Accuracy: 10 m to less than 1 cm
- Vertical accuracy ~ 4x worse than horizontal

GPS: Limitations

- Environment
  - line of sight, atmosphere
- Geography
  - GPS coverage, DGPS coverage
- Politics - DoD SA
- User error

GPS: PRO

- Only collect the data you want
- Highly accuarate, easy to operate
- Much cheaper than traditional surveying
- Quick data collection
- No known benchmarks are needed

GPS: CON

- External factors can limit accuracy and coverage
- GPS Unit can be expensive especially if high accuaracy is desired

Digitize

- Good for collecting data from paper maps
- Only collect the data you want
- Need equipment or contractor
- Accuracy: Only as good as source data/map
- Could be very expensive and time-consuming

Digitize

PRO

- Only collect the data you want
- Data is in vector format - no conversion needed
- Accuracy and precision can be controlled by digitizer

CON

- Accuracy: Only as good as source data/map
- Need equipment or contractor
- Could be very expensive and time consuming

Raster Data Sources

County Digital Orthophotography (U.S.G.S.) - DOQ

- DOQ - Digital Orthophoto Quarter Quad. One file makes up 1/4 the area of a 7.5 Minute quadrangle map
- Displacement errors and distortions are removed. Distance and scale are the same at any scale
- 1991-92 NAPP photography
- Accuracy: +/- 33 Feet
- 1 meter resolution OK for maps at 200 scale
- Cost: $32. USGS ESIC; 1400 Independence Rd; MS 231; Rolla, MO 64501-2602 573-308-3500

Graphic of higher order DOQ point on street intersection

County Digital Orthophotography (U.S.G.S.) - DOQ

PROS

- Good, inexpensive backdrop for editing vector files
- MN is included in entire coverage area

CONS

- Not high accuracy images
- Resolution not detailed enough to pick out signs and other planimetrics

'97 Digital Orthophotography 7 County Metro Area

- Same horizontal positional accuracy as '91-'92 USGS DOQs
- .6 Meter resolution. Scanning resolution was higher.
- Features are still recognizable on maps printed at 100 scale
- One CD contains extent of a 7.5 Minute USGS Quadrangle
- Cost: $20 for one CD. No cost for metro area units of government
- Address: Regional Data Center; Metropolitan Council; Mears Park Centre; 230 E. 5th Street; St. Paul, MN 55101 651-602-1140

'97 Digital Orthophotography 7 County Metro Area

PROS

- Same advantages as USGS DOQs
- Higher spatial resolution: stoplights and turn arrows can be seen
- More recent flight

CONS

- Not high accuracy images
- Only cover 7 County Metro area

Commercial Aerial Photography

- Products: aerial photos, vector data, digital orthophotography
- Typical resolution of digital orthophotography: 1/2 foot
- Markhurd 612-420-9606
  Horizons 612-931-9869
  Martinez 651-291-1127

Commercial Aerial Photography

PROS

- Flexibility in terms of accuracy and types of physical features captured
- Flexibility in when flight is done
- Excellent spatial resolution

CONS

- Expense increases with accuracy

1996-98 NAPP Photography

- Black & White leaf-on photograpy
- Most roads are visible
- Are aerial photos only. Not DOQs. Photos can be scanned and registered to match any map projection system.
- Accuracy: +/- 33 Feet.
- Standard photo size is 9" by 9". Cost: $10. 3 foot enlargement - $33
- Can be ordered over the Internet.
- http://edcwww.cr.usgs.gov/srord-link.html
- Phone: 1-800-252-GLIS

1996-98 NAPP Photography

PROS

- Useful for updating features
- Inexpensive data source

CONS

- Not good for areas of large vertical relief
- Not high accuracy

Commercial Satellite Imaging

- Mapping can be customized or archives can be ordered
- Options for rectified and unrectified aerial imagery in hard copy or digital formats
- Capable of 1 meter resolution with +/- 2 meter horizontal positional accuracy
- Images can be panchromatic or pan-sharpened multispectral
- Space Imaging (http://www.spaceimaging.com)
  Earthwatch Inc (http://www.digitalglobe.com)
  Orbital Imaging Corp. (http://www.orbimage.com)

Scanning Existing Data

- Scan existing maps or air photos
- Scanning produced raster data format
- Raster to vector conversion needs to be done to use data as base map

Scanning

PRO
- Quick
- Good option if existing data is not digital

CON
- Need lots of space - ~10-40 mb
- Potential quality problems
- Raster to vector conversion can degrade precision
- Only as good as source data

USGS Data

- DLG (Digital Line Graph)
  - Similar coverage as TIGER
  - 1:24,000 for some areas
  - 1:100,000 for entire country
- DRG (Digital Raster Graphic)
  - Raster images of topo maps
- DEM (Digital Elevation model)
  - raster files with elevation data
- Other - Land Use/Land Cov, Satellite images, hydrography, etc...

Web: http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/ndcdb.html

LMIC (Land Management Information Center)

- Data Repository for Minnesota
- Data from USGS, MnDNR, MnDOT, etc..
- Boundaries, Geology, Hydrology, Land Use, Soils, Digital Images, Socio-demographic, Transportation and Utilities, USGS Data, etc..
- Web: www.lmic.state.mn.us

Massaging the Data

Massaging the Data - Dan

- Almost all data needs some massaging for use in your project.

Potential Problems with Collected Data

- Data quality
- Different projection/coordinate system/datum
- Data incompatability

Data Quality

- Quality of source data
- Data collection standards
- Source data processing (pre acquisition)

Different projection/coordinate system/datum

- UTM data and Stateplane data will not match
- Data may have unknown or local coordinate system
- Most GIS packages can convert between common systems
- Error
  - Projection: Infinite
  - Coordinate system: Infinite
  - Datum: In Minnesota 5 - 250 feet

Coordinate Systems and Datums of Typical Data Sources in Minnesota

Source	Projection	Datum
MnDOT Base Map98	UTM	NAD83
Met Council GBF	UTM	NAD83
USGS DOQs	UTM	NAD27
USGS DRGs	UTM	NAD27
USGS DLGs	UTM	NAD83
TIGER Files	UTM	NAD27
Sample data from ArcView	Latitude/Longitude*	NAD27
Existing County CAD Files	Depends on County**	NAD27 or NAD83
GPS Derived Data	Latitude/Longitude*	WGS84

*Latitude/Longitude is not a map projection, but is treated as one in many GIS packages.
**These files are typically in the MN County Coord. System. Each county has a different system, however, all but 11 counties use the Lambert Conformal Conic projection.

Data Incompatibility

- Scale
- Data Types
- Accuracy/quality

The Electronic Map

- Map with no data just linework
- Relatively useless for analysis
- Next step is to link it to attribute data and then let GIS do its stuff!!!

Linking the Data: Functional

Linking the Data (Functional)

Case Studies:

Applications in Pavement & Asset Management

Overview of Current Applications in Pavement & Asset Management

Pavement Management and Analysis using GIS

Snow Plow Maintenance Facilities Planning

- GIS can do network modeling
- Given a road network, GIS can estimate travel times
- Allocation problems can be solved and most efficient routes can be determined
- Snow plow maintenance facilities planning is an application of GIS network modeling

Snow Plow Maintenance Facilities Planning

- Input data for roads layer: road network, time to clear road lanes, intersection and turnaround clearing time, delay for crossing bridges and waiting at stop signs and stop lights
- Input data for maintainence facilities (shops): maximum time for a plow to be plowing, shop capacity time
- Output data: Map allocating roads to shops, statistics on shop allocation % and maximum travel time

Emergency Dispatch and Rural Addressing

- Rationale for putting rural addressing into a digital format
- Roads database linework: reshaped TIGER files using DOQs as a base .
- Roads database attributes: road name, type, suffix direction, alternate name, quarter section to left and right, address range, and EMS zone

Emergency Dispatch and Rural Addressing

- Sheriff's township maps scanned and registered to match DOQs. Used as a guide for digitizing structure locations
- Structure locations digitized from DOQs. Address database derived from structure database
- Address database attributes: house number, street name, type, suffix direction, alternate name, quarter section, and EMS zone
- GIS customized to simplify display of sheriff's map and other data for emergency dispatch operators

Snow Plow Maintenance Facilities Planning

Case Study: Manitowoc County, Wisconsin

Goals:

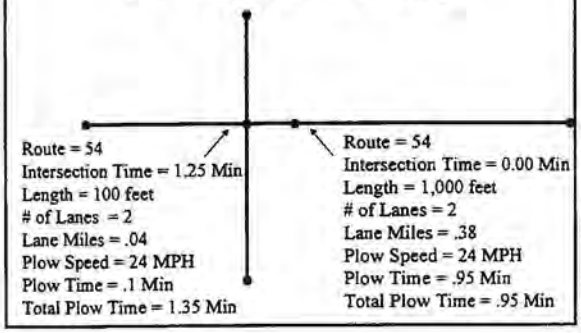
- Pick the best possible location for the main shop
- Determine feasibility of combining and/or closing shops
- Decrease plowing response times

Snow Plow Maintenance Facilities Planning

Database Development

- State roads - GIS files from the state of WI
- County roads - CAD files. Transformed to match projection of state roads file
- Coded roads with necessary attributes: travel speeds for plowing and deadhead, route #, intersection clearing time, # of lanes
- Calculated plow time and deadhead time and total plow time

Road Attribute Coding



Snow Plow Maintenance Facilities Planning

Validating/Calibrating Database

- Each route generally takes 150 minutes to plow
- Statistics summarized for each route pinpointed errors and omissions

Route #	Lane Miles	Plow Speed (calculated)	Total Plow Time
3	54.76	21.9 MPH	150 Min
16	42.15	16.86 MPH	150 Min
54	39.14	15.65 MPH	150 Min

Snow Plow Maintenance Facilities Planning

Analysis

- The GIS allocation model was run to show maps and generate statistics for each proposed scenario

Scenario	Max. Response Time (weighted avg.)	Deadhead Time
Existing	53.56 Minutes	43.34 Minutes
7. Main to 151	45.38 Minutes	66.30 Minutes
8. Main to JJ	45.21 Minutes	47.29 Minutes
9. Main to 310	48.04 Minutes	58.30 Minutes
10. Main to 310 and Close shop	51.40 Minutes	74.27 Minutes

Snow Plow Maintenance Facilities Planning

Results

- Although alternative 8 was best, alternative 9 was the most politically feasible
- County wanted to know what would happen if the trucks from the Cleveland shop were added to the St. Nazianz shop. Alternative 11
- Alternative 11 was feasible. The amount of response time was greater than for the existing system

Ditch Maintenance Record Keeping

Implementation of the Project

- Ditch Record Keeping Issues
- Consensus Building Process
- Funding

Ditch Maintenance Record Keeping

Database Development

- Scan and register ditch maps to match projection of the DOQs
- Reshaped TIGER hydrography to match DOQ
- Digitized ditches and tile off of DOQs and scanned ditch maps
- Digitized wetland and ditch watershed boundaries from scanned ditch maps

Ditch Maintenance Record Keeping

Data Access and Applications

- Data Access interface
- Locating ditches that are sprayed
- GIS hotlink to notes on ditch maintenance
- Printing out ditch maps

Mn/DOT Hydraulic Infrastructure

Stay away from the shore if you don't want to get wet.

- Advantages
- Disadvantages

Project Objectives

- Support Business' need:
  - Manage hydraulic infrastructure
- Support IRM Plan

Manage Data

- Shareable
  - Accessible
- Efficient
- Integrity

Support IRM plan

- Refine Data Model
- Create Shareable Data
- Create Shareable Applications

Mn/DOT Hydraulic Infrastructure

Benefits

- Inventory
- Inspect
- Manage

Inventory

- Existence
- Location
- Crisis Response
- NPDES
  - National Pollution Discharge Elimination System

Inspect

- Infrastructure Condition
- Public Safety
- Life Cycle Analysis

Manage

- Program Scoping
- Project Planning
- Operations
- Maintenance

Project Deliverables

- Usable Application
  - Hydraulic Facility Management
- Recommendations
  - Statewide Implementation Strategy
  - Future Facility Management Projects

Deliver to Whom?

- Knowing customer
  - End users — application — prototype
  - OIP — follow IRM — model
  - ILC — on time, in budget — reports
- Hire the right people
- Risk analysis

Assumptions

- User Interface
  - GIS
  - Standard Menu (Windows)
  - Handheld Data Collection
- Technology
  - Variability in equipment
  - 32 and/or 16 bit
  - GPS data accuracy

Data Sources

- GPS Location and Data Collection
- Camera Van for Video Images
- Input Forms
- Ancillary Digital Data

Data Issues

- Data stewards (local/global)
- Conversion of data
- Image and video documents
- Spatial information

Data: Soft

- Mile post to true miles
- Differential signal
- GPS data collector
- HWY coverage

Missing Components

- Model data spatially
- Need statewide resolution of:
  - linear & geographic reference systems
  - make basic data available

Variables

- Associated Applications
- Network Clients
- How Best to Train
  - Assumption of Development
  - Selling Application to Users

Timeline

• Modeling	7 months
• Contract Development	3 months
• Programming	6 months
• Pilot Project	14 months
• Statewide Implementation	3 - 5 years

Project Cost

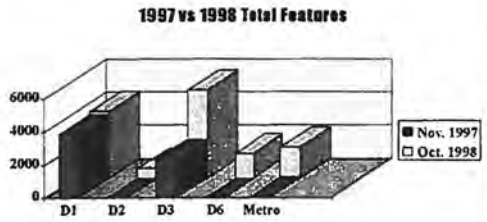
• Project Planning & Management	$9,400
• Modeling	$65,000
• Development	$179,000
• Implementation, Equipment, & Initial Data Capture	$864,000*
• Ongoing Annual Cost	$145,000*

APPLICATION

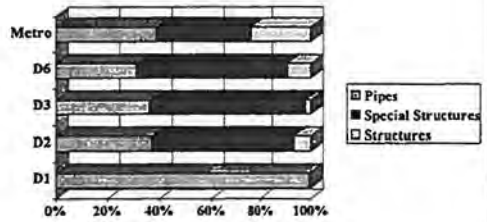
- ArcView™
- Oracle Forms™
- Pathfinder Office™
- InterSolv ™ ODBC
- Customers

Mn/DOT Districts

Number of Records



Type of Features



Uses of HYDINFRA Data

- STIP process
- Maintenance Repair
- Program Planning
- Public Presentations
- Reports

Uses for HYDINFRA Data

- Additional Uses
  - New Design Policies (tie entire feature)
  - Trigger Improved Maintenance
  - Inspectors Found Holes
- Unrelated Uses
  - Verify Edge of Pavement
  - Verify Milepost on Basemap

GIS Interface

Forms Interface

Reports

OSM was selected by McLeod County to integrate data pertaining to county ditches into a geographic information system (GIS). County officials needed a more efficient way to access information pertaining to county ditches. As a result of this project, they can quickly view ditch map and related information on their computers.

The final products of this project are digital air photos (DOQs) showing the land, ownership patterns, roads and ditches, along with other geographic data. Superimposed on the DOQs are scanned images of the original ditch maps, scaled and positioned to fit the photo. The ditch features are captured as lines in a computerized map. A database of information is linked to each line segment, so that maintenance information can be stored and retrieved in combination with the photo and ditch map images.

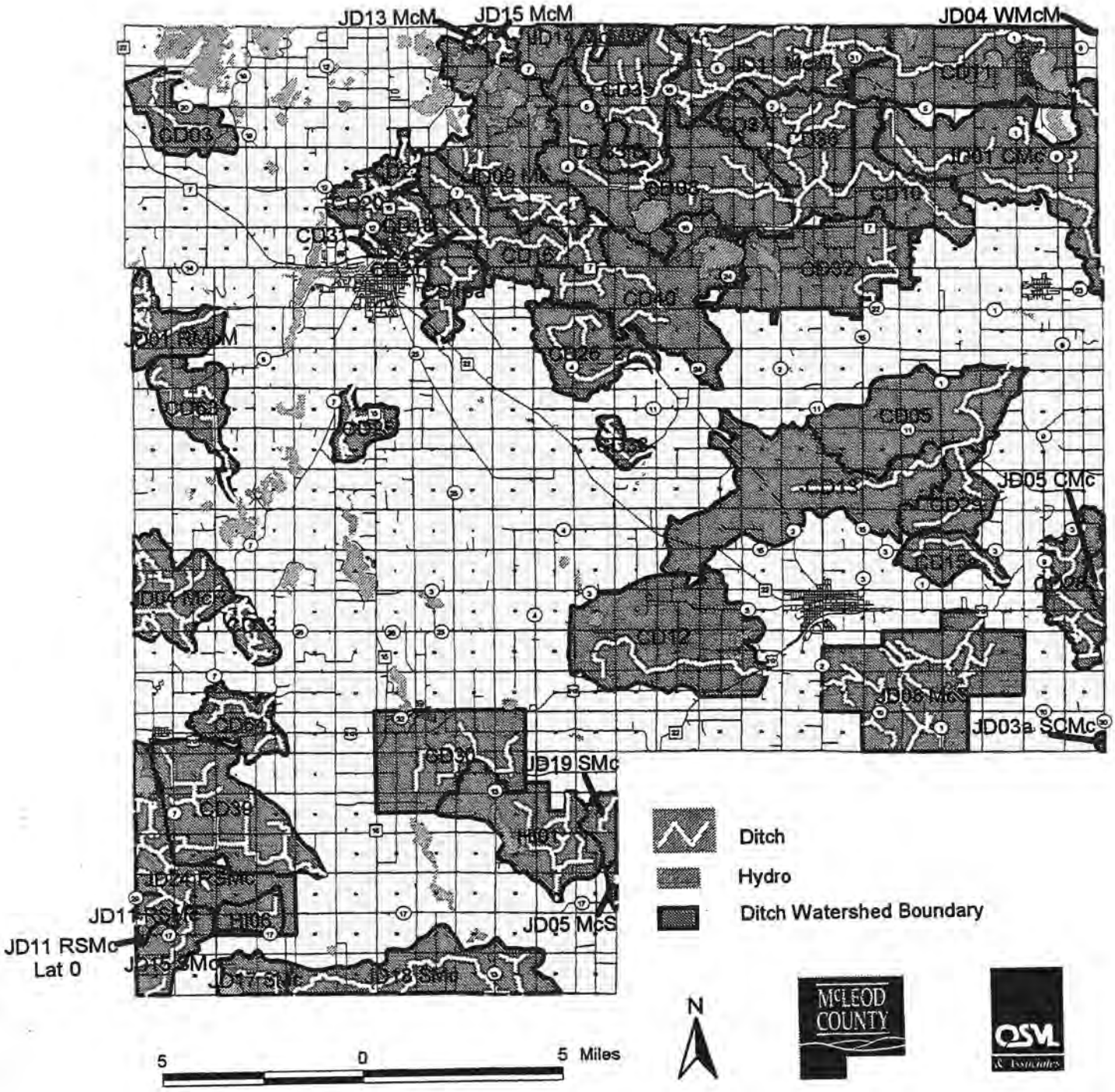
OSM's work with McLeod County involved the following tasks: Each county ditch map was scanned. The DOQs and scanned ditch map images were then registered to match the map projection of the county's other geographic data. Existing TIGER hydrography and roads data layers were edited, so that they would correctly align with the DOQ basemap. Ditch watershed boundaries were digitized from the scanned ditch maps and assembled into a county-wide ditch watershed coverage. Public Land Survey (PLS) section line coverages were created using DOQs and county supplied GPS points as a reference. The accuracy of the DOQs, as stated by USGS, is +/- 33 feet. However, OSM found that most of McLeod County's GPS points came within about 10 feet of where one would guess them to be from the DOQ. This means the DOQs are an excellent reference source for a base map in other counties when no GPS work has been done. PLS quarter section line coverages were computed and edited using DOQs and GPS points as a reference. From these, quarter-quarter section line coverages were computed and created. Using the scanned ditch maps as a reference, the quarter-quarter section coverage was edited to create a land ownership coverage with attributes describing the owner's name, acreage and PLS information.

In addition to addressing ditch map issues, this project will have long term benefits for the County. Using the TIGER road coverage, rural addresses can be added as attributes and used by the County Sheriff for 911. The air photos can be used by the planner and the assessor to determine the locations of structures in the County. The quarter-quarter section line coverage can provide a framework for parcel mapping on an interim basis until more accurate parcel maps are created.

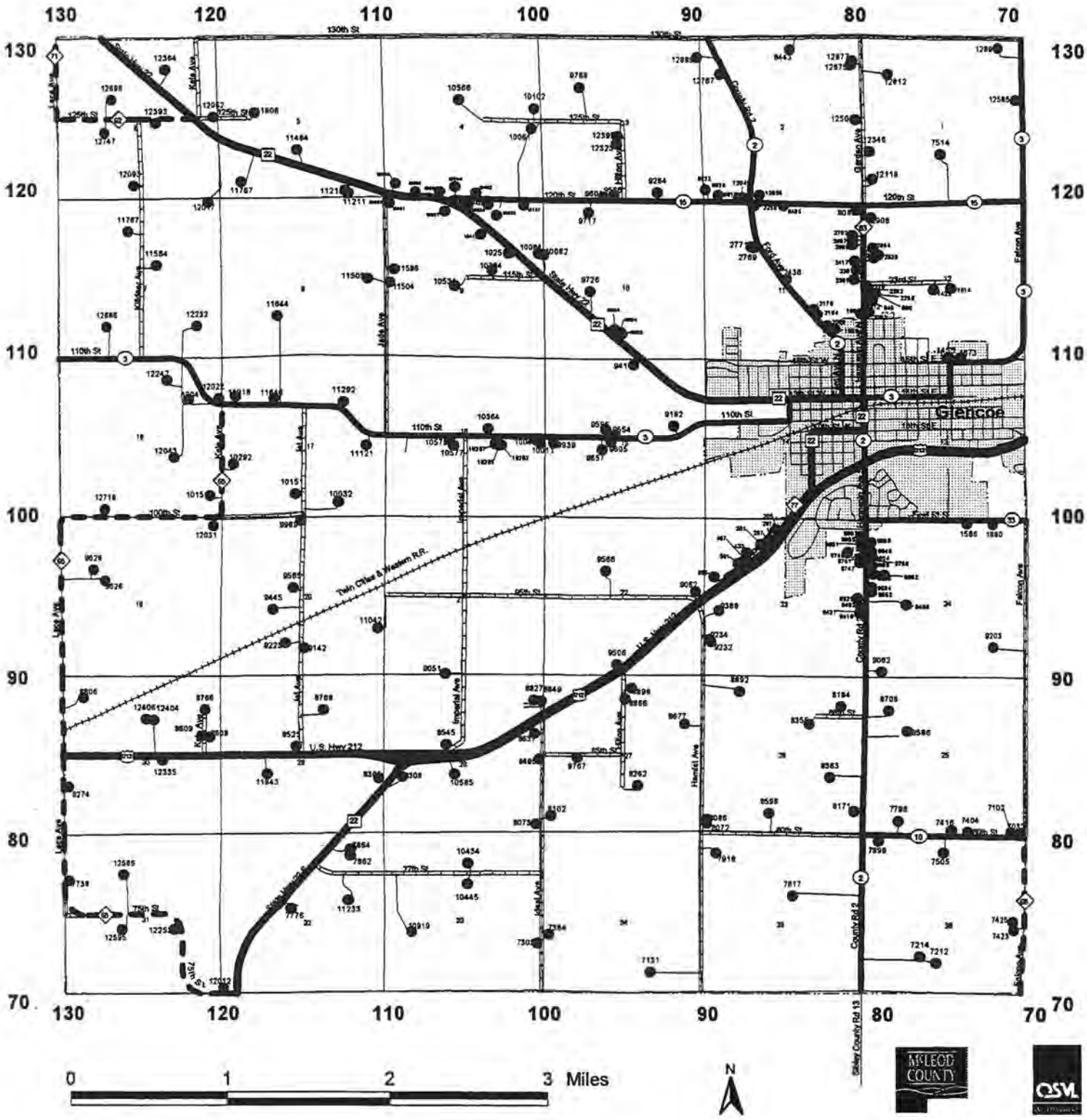
Case Study Maps

McLeod County

Drainage Inventory



Glencoe Township
Rural Addressing



Implementation Principles:

Who, What, How

Implementation Principles

GIS as a Management Tool

- Traditional Asset Management Systems - good at the who, what and why
- GIS - good at the where

GIS as a Management Tool

- Why use GIS to collect and manage data?
  - Many projects fail
  - Many deliver less than promised

GIS as a Management Tool

- Why use GIS to collect and manage data?
  - Many projects are successful
  - Many deliver as promised or exceed expectations

GIS as a Management Tool

- Why do projects fail:
  - Mission
  - Consensus
  - Research
  - Objectives
  - Planning

GIS as a Management Tool

- To be successful GIS projects must:
  - Be considered and evaluated more as business decision

Overview of Data Collection Process

Defining Your Overall Purpose:
or Cutting edge technology
without the blood

Presentation Agenda

- Mission statement
- Identify needed data
- Data evaluation
- Methods
- Implementation plan

Mission Statement

- What is the purpose of a mission statement:
  - Identify
  - Unify
  - Empower

Mission Statement

- Identify:
  - Who
    - Participants
    - Best fit
  - What
    - Goals
    - Data

Mission Statement

- Who
  - Street department
  - Sewer department
  - Administration
  - Elected officials
  - IS department

Mission Statement

- What (goals)
  - Street and Sewer Departments -
    - Where should we be working?
    - When should we be there?
    - What should we be doing?
  - Administration - How much should we be spending?
  - Elected officials - What is the benefit of funding?
  - IS Department - Coordinate where work is performed?

Mission Statement

- What (data)
  - Location (pavement, signs and sewer structures), inventory, condition. historical, financial, etc...
  - Accuracy
    - Streets - within two meters
    - Sewers - within one half meter.
    - Administration - within five meters.
    - Elected officials - so the map looks good at a council meeting

Mission Statement

- The purpose of this project is to provide the street and sewer departments, administration and elected officials with easy to understand and use location, inventory, condition, historical and financial information about pavements, signs and sewer structures within the right of way to better optimize, coordinate, present, fund and track maintenance and rehabilitation.

Identify Needed Data Based on Mission

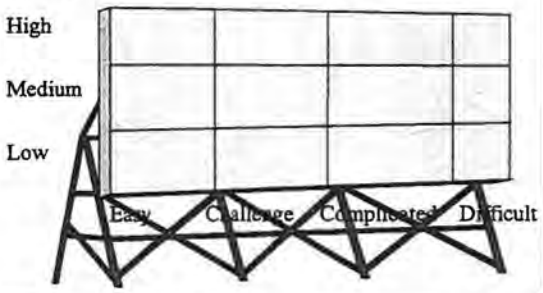
- Identify Data sources:
  - Existing paper maps
  - Card files
  - Staff
  - Databases

Identify Needed Data and Methods Based on Mission

- Research each area.

Strengths	Weaknesses	Opportunities	Threats
Vision	Funding	Shared data	Control
Existing data	Experience	Shared cost	Access to data
New technology	Training		
Staff			

Identify Needed Data and Methods (Evaluate S.W.A.T. based on Mission)



Identify Needed Data Based on Mission

- Suitable - must make a reasonable contribution to the mission.
- Feasible - achieve objective considering analysis.
- Flexible - modifiable due to contingencies.
- Motivating - aggressive but not out of reach.
- Understandable - simple and unambiguous.
- Linkage - consistent with mission.

Identify Methods Based on Required Data

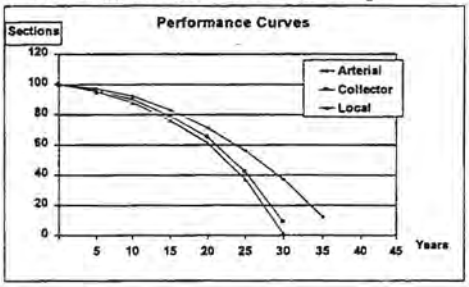
- Identify Methods:
  - Total station
  - GPS
  - Staff interviews
  - Consultant
  - Agency Champion

Implementation Methods Based on Required Data

- Use GPS data collection methods for accuracy, low cost
- Collect digital video for elected officials

Implementation Methods Based on Required Data

- Performance data must match current strategies



Implementation Plan Developed from Methods

Implementation Tasks

- Needs Assessment
- Network Definition
- GPS Data
- GIS Integration
- Condition Data
- Quality Control
- Historical Data Review
- Distress Analysis
- Performance Modeling
- Maintenance Strategies
- "What if" Scenarios
- Software Installation
- Training
- Presentation
- Multi-Year Planning
- Support

Developing Your Implementation Plan

- Mission statement
- Identify needed data
- Data evaluation
- Methods
- Implementation plan

Selection Criteria

- Agency wide solution
  - User friendly - Easy to use/adaptable
  - Comprehensive - Provide detailed information
  - Robust system - Can include other department operations and databases
  - Integrated - Link with standard GIS products
- Telephone and modem support
- Vendor must offer user group meetings and training sessions, in excellent hunting area
- Neighboring or related agencies using software currently
- Market Niche
- Ability to upgrade(features) without having to buy new system

Tools Available

- LowEnd Applications
  - ArcView, Mapinfo, AutoCad Map, Geomedia, Integraph World, Atlas GIS
  - Cost: $500-1,500
  - PC based
  - NT and Win95-98
- High End Applications
  - ArcInfo, Integraph MGE, Smallworld
  - Cost: $5,000-$10,000
  - PC and Workstaion based
  - NT and UNIX

Question and Answer

Reading List, Data Sources & Software Vendors

READING LIST

General GIS Info

Adams Book Guild
1-800-396-3939

ESRI book store
http://www.esri.com/gisstore

EOWorld Magazine
609-786-7364
http://www.geoplace.com/gw/

MN GIS/LIS Consortium
http://www.mngislis.org

MN Governor's Council of Geographic Information
http://www.lmic.state.mn.us/gc/gc.htm

Wisely's GIS Yellow Pages
http://sunflower.singnet.com.sg/~wisely/gislist.htm

Urban and Regional Information Systems Association
http://www.urisa.org/

Data Sources (Government)

Borchert Map Library
612-625-9024
http://www-map.lib.umn.edu/

BWSR - Board of Water and Soil Resources
651-296-3767
http://www.lmic.state.mn.us/gc/dir/mnbwsr.htm

MN DNR
651-297-2329
http://www.dnr.state.mn.us
http://www.dnr.state.mn.us/mis/gis/tools/arcview/

LMIC - Land Managment Information Center
651-296-1211
- home page at http://www.lmic.state.mn.us
- general catalog at http://www.lmic.state.mn.us/catalog
- Base Maps for the 90's at http://www.lmic.state.mn.us/bmap/bmap90.htm

Metropolitan Council
http://www.metrocouncil.org

Metro GIS
651-602-1638
http://www.metrogis.org
- data finder search tool at http://www.datafinder.org/

MN Geological Survey
612-627-4780
http://www.geo.umn.edu/mgs

MNDOA - MN Dept. of Administration, Technology Management Bureau
http://www.state.mn.us/ebranch/admin/ipo/newindex.html

Mn/DOT
- base map CD 651-215-1973 or gisinfo@dot.state.mn.us

NRCS - Natural Resources Conservation Service
- State Soil Scientist Office at 651-602-7861
- MN NRCS office at http://www.mn.nrcs.usda.gov/
- MN Soils http://mn.nrcs.usda.gov/soils/soils.html

U.S. Census Bureau - Information and downloadable data
- Customer service 301-457-4100
- http://www.census.gov/

USDA - U.S. Department of Agriculture Aerial Photography Field Office
801-975-3503
www.fsa.usda.gov/dam/APFO/airfto.htm

USGS - United States Geological Survey
1-800-USA-MAPS

USGS - Earth Science Information Center (ESIC)
- for USGS paper and digital products
573-308-3500
http://www.mcmcweb.er.usgs.gov/esic/

USGS - EROS Data Center
- for aerial photography and satellite image products
605-594-6151 or custserv@edcserver1.cr.usgs.gov
- ftp files at http://www.edcwww.cr.usgs.gov/dsprod/prod.html
- or http://www.edcwww.cr.usgs.gov/doc/edchome/ndcbd/ndcbd.html
- FTP via State site at edcwww.cr.usgs.gov/glis/hyper/guide/100kdlgfig/states.html
- DLG to DXF conversion utility site members.visi.net/~ddbunch/dlglx.htm

USGS - Biological Resources Division
http://www..emtc.nbs.gov/

USFWS- U.S. Fish and Wildlife Service
- NWI - National Wetlands Inventory data
ftp://enterprise.nwi.fws.gov

Data Sources (Private)

American Digital Cartography
1-800 236-7973
www.adci.com

ETAK
1-800-765-0555
www.etak.com

GDT - Geographic Data Technology
1-800-331-7881 or info@gdt1.com
www.geographic.com
- Wessex a division of GDT
http://www.wessex.com/wessex/wssxhome.htm

Map Data Online
http://www.mapdata.net/resources/freewebdata.html

GIS Software Vendors

AutoDesk
AutoCad Map, AutoCad World
www.autodesk.com
1-408-517-1700

ESRI
Arc/Info, ArcView, MapObjects
www.esri.comww.esri.com

1-800-447-9778

Intergraph
Geomedia, GIS Office, MGE
www.intergraph.com
1-888-779-3824

Mapinfo Corp
Mapinfo
www.mapinfo.com
1-800-FASTMAP

Smallworld
Smallworld 3
www.smallworld-us.com
1-303-779-6980

GPS Vendors

Ashtech/Magellan
www.ashtech.com
1-800-922-2401

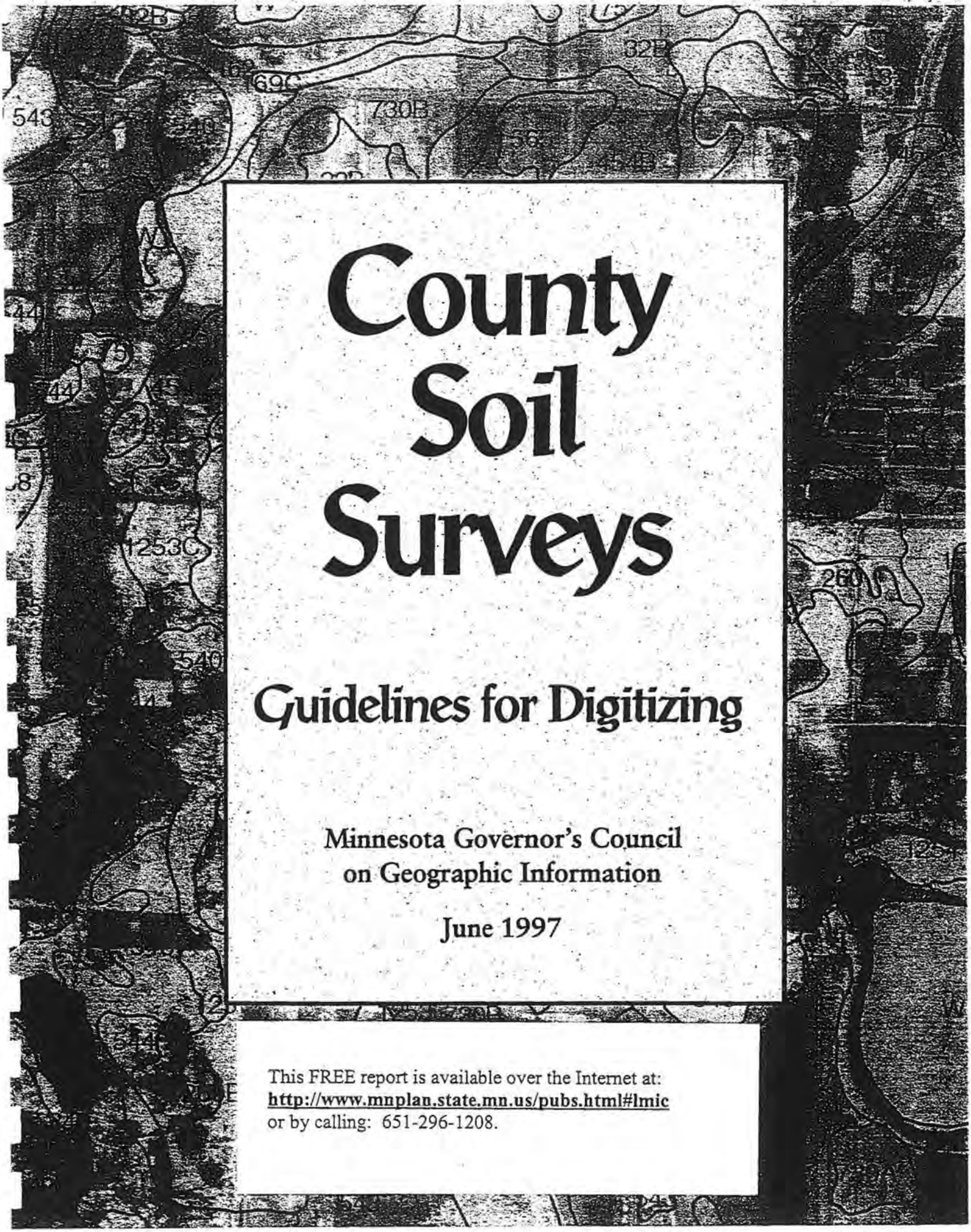
Novatel
www.navatel.com
1-800-NOVATEL

Sokkia
www.sokkia.com
1-800-476-5542

Trimble
www.trimble.com
1-408-481-8000

Publications & Resources:

MN Governor's Council on GIS



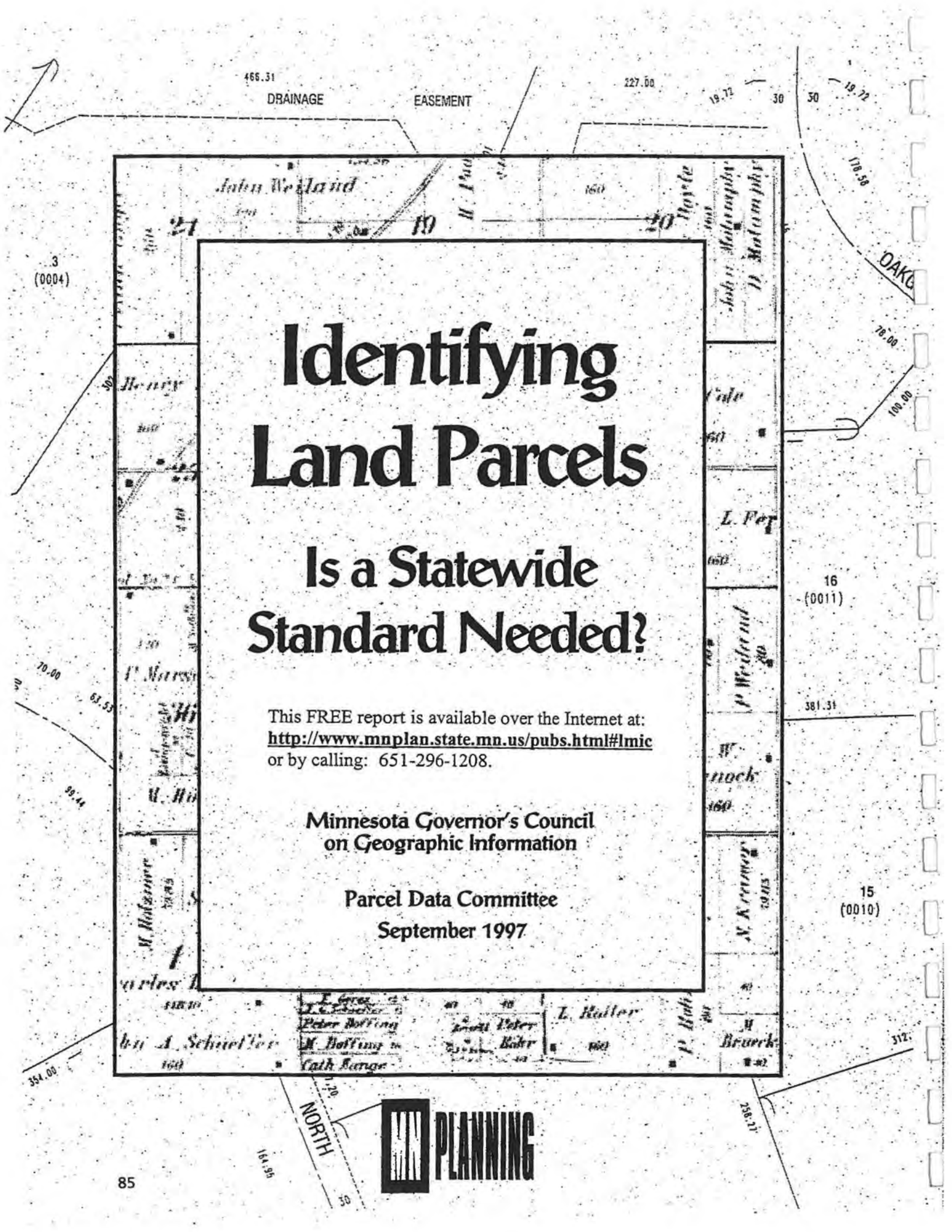
County Soil Surveys

Guidelines for Digitizing

Minnesota Governor's Council
on Geographic Information

June 1997

This FREE report is available over the Internet at:
http://www.mnplan.state.mn.us/pubs.html#lmic
or by calling: 651-296-1208.



Identifying Land Parcels

Is a Statewide Standard Needed?

This FREE report is available over the Internet at:
http://www.mnplan.state.mn.us/pubs.html#lmic
or by calling: 651-296-1208.

Minnesota Governor's Council on Geographic Information

Parcel Data Committee

September 1997

MN PLANNING

Publications and Resources

The following documents are available by visiting the council's home page at **www.lmic.state.mn.us/gc/gc.htm** or by sending an e-mail to gc@mnplan.state.mn.us or calling the council coordinator at 651-296-1208

- *Cardinal Points: Fiscal Year 1998 Annual Report of the Governor's Council on Geographic Information (August 1998)*
- *Laying The Foundation for a Geographic Information Clearinghouse (August 1997)*
- *Charting Progress: Fiscal Year 1997 Annual Report of the Governor's Council on Geographic Information (August 1997)*
- *Numeric Codes for the Identification of Counties in Minnesota (July 1997)*
- *County Soil Surveys: Guidelines for Digitizing (June 1997)*
- *Minnesota Geographic Metadata Guidelines (September 1996*
- *Starting Points: Conventions for Geographic Information (September 1996)*
- *Resource List for Parcel Data Development (August 1996)*
- *Seeking Common Coordinates: Fiscal Year 1996 Annual Report of the Governor's Council on Geographic Information (June 1996)*
- *By-laws of the Governor's Council on Geographic Information (March 1996)*
- *Standards for GIS (September 1995)*
- *Progressing on Course: Fiscal Year 1995 Annual Report of the Governor's Council on Geographic Information (June 1995)*
- *Analysis of the 1994 survey of Minnesota GIS users: Adequacy of the current data and needs for new or improved data (May 1995)*
- *Survey of Current GIS Data and Needs: Technical Report (May 1995)*
- *Mapping a Course of Action: Fiscal Year 1994 Annual Report of the Governor's Council on Geographic Information (June 1994)*
- *Executive Order 93-17 providing for the establishment of a Governor's Council on Geographic Information (August 1993)*